1. **CV of the researcher**

***Niteen Kumar***

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**ResearchGate:** https://www.researchgate.net/profile/Niteen-Kumar-3

**Google Scholar :** https://scholar.google.com/citations?hl=en&tzom=-330&user=1AVHRmMAAAAJ

**Professional Experience**

* **Project Engineer, VoltaicsAlpha, New Delhi, India 01/01/2024 – Present**
  + Modelling and optimization
* **Technical advisor, Augora, New Delhi, India 01/09/2022 – 20/12/2023**
  + Modelling and optimization
* **Visiting faculty,** University of Kassel, Kassel, Germany **22/05/2022 – 22/06/2022**
* **Course:** Numerical solution of partial differential equations
* **Research:** Development of Modified-Patankar Runge Kutta method for point reactor kinetic equation
* **Postdoctoral fellow,** University of Geneva, Geneva, Switzerland **01/09/2021 – 30/08/2022**
  + Development of a multiscale capable nodal integral method
  + Nodal integration method based on domain decomposition techniques
  + Simulation and dispersion analysis of wave equation using the nodal integral method
  + Nodal integral method for hyperbolic wave equation
    - * **Technical Advisor, Pontoka** **01/05/2021 – 30/08/2021**
* Modelling and optimization, emission quantification
* **Postdoctoral fellow,** Indian Institute of Technology Bombay, Mumbai, India **01/09/2020 – 30/08/2021**
  + Stability analysis of two-phase flow in heated channels
  + Development of node averaged nodal integral method **(Mentor)**
  + Convergence study of Newton-based nonlinear solvers **(Mentor)**
* **Research Associate,** Indian Institute of Technology Bombay, Mumbai, India **30/12/2019 – 30/06/2020**
  + Nodal integral method for the acoustic wave equation
  + Error analysis of NIM in cylindrical geometry for neutron diffusion equation **(Mentor)**
* **Project consultant,** EnergyDesign Co. Shanghai **25/09/2019 – 18/11/2019**
* Technical consultant for an international school green campus
  + - * **Research Assistant,** Indian Institute of Technology Bombay, Mumbai, India **23/03/2019 – 23/06/2019**
        + Mathematical modeling of batteries system
      * **Teaching Assistant,** Indian Institute of Technology Bombay, India **22/07/2011 – 22/03/2019**
        + Energy Systems and Modelling
        + Power Generation and System Planning
        + Non-conventional Energy Resources (laboratory)
        + Computational Laboratory
        + Energy Management

**Education**

* **Doctor of Philosophy,** Indian Institute of Technology Bombay, India **Awarded on - 23/08/2020**

Thesis Title: *Nodal Integral Method using Jacobian Free Newton Krylov Approach for Burgers' Equation*

**Key Research Features**:

* A framework of nonlinear solvers in conjunction with the nodal integral method (NIM)
* Strategy to find a better initial guess for Newton-based solvers to achieve quadratic convergence
* Development of physics-based preconditioner for Jacobian Free Newton Method (JFNK)
* Simulate shock wave using viscous Burgers' equation (1D and 2D)
* Preconditioning effect on spectral properties, rate of convergence of residual, and CPU runtime
* **Master of Science,** Indian Institute of Technology Bombay India **Awarded on - 23/08/2020**

Project Title: *Numerical study of fluid flow problem using the nodal integral method*

**Key Project Features**:

* Developed nodal integral scheme for Burgers’-Huxleys equation
* Implementation of numerical solvers: Gauss-seidel, Picard method, Newton method, Newton-Krylov method, Jacobian Free Newton Krylov method
* Solve benchmark problems: heat diffusion, convection-diffusion, Navier-Stokes equation, Burgers' equation.
* **Bachelor of Science (with distinction),** St. Xavier’s College, Ranchi **Awarded on - 01/11/2010**

Project Title: Working prototype of the RAMJET engine

**Track record**

I was the *first to initiate research*on the topic of preconditioning of numerical methods in my department during a Ph.D. During my Ph.D., I have acquired strong skills, knowledge, and experience in *Nodal Integral Method* (NIM), *Jacobian free Newton Krylov* (JFNK) solver, and preconditioning, and numerical analysis. I have *12 years*of working experience in the field of numerical analysis and modeling. My Ph.D. was focused on improving the computational efficiency of NIM, for solving nonlinear problems using Newton-based solvers. Two numerical algorithms were developed for 1D and 2D problems. The first algorithm, based on a predictor-corrector method, found *a better initial guess for the Newton method*. The algorithm also benefited from the inclusion of the *JFNK method*, avoiding the construction of Jacobian matrices, thereby reducing the computational overhead. The second algorithm was a *physics-based preconditioner* for reducing the number of Krylov iterations of the JFNK method. All these works got published in reputed peer reviewed journals.

During the Ph.D., I *co-supervised two masters’ students*; by helping them in solving benchmark problems followed by effective writing skills. One of the students went for Ph.D. and the second one is working as a data scientist. After my Ph.D., I joined IIT Bombay as a *Research Associate*. During my stay at IIT Bombay, I was one of the founding members of student research team "*Team Shunya*" to compete in *Solar Decathlon Europe 2014 (Paris)* and *Solar Decathlon China 2018 (Dezhou)* and acted as a*mentor* to *undergraduate & postgraduate* students to *design and build a passive solar house*. In 2017, I was a member of the organizing team for *International Conference on Advances in Energy Research-2017*, reviewed abstracts for more than *200 research* papers with a team of 10 people; organized and managed sessions. During Ph.D., I acted as a *Teaching Assistant* at IIT Bombay for courses such as computational lab, system modeling and optimization, solar thermal and energy conversion lab, etc. and helped professors in the course *structure designing, taking tutorials, and paper evaluation*. In 2019, I worked as a *Research Assistant (March 2019 – June 2019)*. In 2019, for a short term, I served as a *Project Consultant* to a company *EnergyDesign Shanghai (September 2019 – November 2019)*based inShanghai.

After my Ph.D., I worked as a postdoctoral fellow IIT Bombay (September 2020 - August 2021), where I worked on the solution of Helmholtz equation using NIM for wave field modelling and stability analysis of two-phase flow, which resulted into publications. During my postdoctoral tenure, I got a chance to mentor one masters student. In September 2021, I joined the applied mathematics group at section de mathematics, University of Geneva as a postdoctoral fellow. There I worked on multiscale diffusion problem, development of NIM scheme for hyperbolic wave equation, a domain decomposition based NIM scheme and dispersion correction of NIM scheme. During my stay at Geneva, I started a collaboration with Prof. Meister from university of Kassel on development of modified Patankar Runge Kutta (MPRK) solver for point reactor kinetic equation. During my visit at university of Kassel, I served as a visiting lecturer at department of mathematics for one month, there I taught numerical solution of partial differential equations. At present I am working on the solution of telegraph equation using NIM. I am also a member of technical resource group for solar decathlon India from last four edition (2021-2024). There my role is to provide technical supports to undergraduate student in designing a sustainable solar powered house.

**Research**

* **Research interest**
* Wavefield modelling, multiscale capable nodal integral method
* Numerical methods, Positivity-preserving discontinous-Galerkin method, Nodal integral method
* Wavefield modelling, Dispersion correction and coefficients optimization,
* Preconditioning, Matrix Free Solvers
* Stability analysis and time integration of dynamical system (MPRK)
* Physics-based preconditioning, Matrix-Free solvers (JFNK)
* **Current research**
* Stability analysis of physical system
* Development of MPRK for point reactor kinetic equation
* Development of nodal integral method based on domain decomposition method
* Development of nodal integral method for hyperbolic partial differential equation
* Development of multiscale capable nodal integral method
* **Publications in peer-reviewed scientific journals**
* **Kumar, N.**, Shekar, B., Singh, S., Nodal integral method for the acoustic wave equation,” Pure and applied geophysics, Vol. 179, Issue 10, 3677-3691, 2022
* **Kumar, N.,** Singh, S., “A Novel Physics-Based Preconditioner for Nodal Integral Method using JFNK for 2D Burgers Equation”, *Progress in Nuclear Energy,* Vol. 134, Article number 103668, 2021
* **Kumar, N.,** Majumdar, R., Singh, S., "Predictor-Corrector Nodal Integral Method for simulation of high Reynolds number fluid flow using larger time steps in Burgers' equation," *Computers and Mathematics with Applications*, Vol. 79, Issue 5, 1362-1381, 2020
* **Kumar, N.,** Majumdar, R., Singh, S., "Physics-based preconditioning of Jacobian free Newton Krylov for Burgers' equation using the modified nodal integral method," *Progress in Nuclear Energy*, Vol. 117, Article number 103104, 2019
* Ahmed, N., **Kumar, N.**, Singh, S. “Physics-based preconditioning of Jacobian Free Newton- Krylov solver for Navier-Stokes Equations using Nodal Integral Method”, *International Journal for Numerical Methods in Fluids,* ***accepted, in print***
* **Peer-reviewed conference proceedings**
  + **Kumar, N.**, Gander, M.J., “A new nodal integration method for Helmholtz problems based on domain decomposition techniques”, Proceedings of Domain decomposition method, 2022
  + Ahmed, N., Kumar, A., **Kumar, N.**, Singh, S., An improved preconditioning algorithm for two-dimensional Burgers’ equation using a nodal integral method for very high Reynolds number, 8th World congress on mechanical, chemical, and material engineering, Prague, Czech Republic, August-2022
  + Ahmed, N., **Kumar, N.,** Singh, S., “Node Averaged Nodal Integral Method”, *In WCCM-ECCOMAS, Paris, France*, January-2021
  + **Kumar, N.,** Singh, S., **“**Numerical Solution of Burgers'-Huxleys Equation using Improved Nodal Integral Method", *International Conference on Computational Fluid Dynamics - 09, Istanbul*, *Turkey*, July- 2016
* **Conference publications**
  + **Kumar, N.**, Gander, M.J., ”Multiscale capable nodal integral method”, In International Conference on Scientific Computation and Differential Equations, Reykjavik, Iceland, July-2022
* **Articles under review** 
  + **Kumar, N.**, Gander, M.J., ”Nodal integral method for hyperbolic wave equation”, Numerical methods for partial differential equations, submitted (June, 2023)
* **Manuscript under preparation**
  + **Kumar, N**., Meister, A., Singh, S.*, “*MPRK method for point reactor kinetic equation”, Under preparation (Targeted journal - Nonlinear dynamics)
  + **Kumar, N.**, Gander, M.J., ” A new nodal integration method for 2D Helmholtz problems based on domain decomposition techniques” Under preparation (Targeted journal - SIAM)

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| **Google scholar** | | **ResearchGate** | |
| Citations | 25 | Citations | 22 |
| h-index | 3 | h-index | 3 |
| i10-index | 0 | Research interest score | 16.1 |
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* **Open-source repositories**
  + <https://github.com/krniteen>
* **Computational skills**
* Languages: C/C++, Fortran
* **Scientific Applications:** MATLAB, Python, Mathematica, Maple, OpenFOAM
* **Packages:** MATCONT, NUMPY, SCIPY, SCIKIT-LEARN, PANDAS, matplotlib, statsmodels
* **Numerical methods:** Finite Difference method, Finite element method, Nodal Integral method
* **Experimental:** Developed and conducted experiments related to non-conventional energy systems
* **Invited presentations to internationally established conferences and/or international advanced schools**
* **Keynote speaker** at an international seminar on “*Indian trade: Status and recent trends”,* October 2021
* **Organization of international conferences/ membership in the steering and/or program committee**
* Decathlete, Sept. 2013- Jul. 2014, Solar Decathlon Europe 2014, selected among 20 international teams
* Forming and heading a department team to showcase in the Techconnect Exhibition of Techfest 2013 and 2014. Received first prize in both the exhibition year
* "Advanced Nuclear Security Workshop for Indian Universities," PDPU Gandhinagar. Conducted by Nuclear Security Science and Policy Institute, Texas A&M University. December 2015
* "Advanced Nuclear Security Workshop for Indian Universities," IIT Kanpur. Conducted by Nuclear Security Science and Policy Institute, Texas A&M University. February 2016
* "International Conference on Advance in Energy Research" Organized by Department of Energy Science & Engineering, I.I.T. Bombay, December 2017
* "Advanced Sensors and Modelling Techniques for Nuclear Reactor safety," IIT Bombay. Conducted by Indo-US Science and technology forum, December 2018
* Co-founded and led Team Shunya, selected among 22 internationa teams in Solar Decathlon China, 2018
* Member of Technical Resource Group for Solar Decathlon India 2020 and 2021, an international competition organized by the U.S. Department of Energy
* **Prizes and Awards**
* Build a SCRAMJET prototype and participation in a science exhibition, awarded first prize
* **Funding received so far**
* Awarded Integrated M.Sc.-Ph.D. Research Fellowship, Ministry of Human Resource and Development, India, July 2011 - July 2018 (Euro 10,000)
* Awarded travel grant to visit International Conference on Computational Fluid Dynamics - 09 (ICCFD-July 2016), Istanbul, Turkey, by Dept. of Science and Technology (DST), Govt. of India. (Euro 1,500)
* Awarded travel grant to participate in Solar Decathlon Europe, June 2014 - July 2014, Paris (Euro 4500)
* Awarded travel grant to participate in Solar Decathlon China, Jul 2018 – Aug 2018, Dezhou (Euro 4500)
* **Supervising and mentoring activities**
* Co-supervised 2 post graduate students in master thesis (one is working in consulting firm, one is about to defend his Ph.D. thesis)
* Development of node averaged nodal integral method
* Error analysis of nodal integral method in cylindrical geometry for neutron diffusion equation
* Convergence study of different Newton based nonlinear solvers
* **International Collaboration**
* Prof. Martin J. Gander (University of Geneva, Switzerland): Ongoing collaboration since September 2020 on development of multiscale capable nodal integral method (NIM), development of NIM for hyperbolic equation, domain decomposition technique based NIM
* Prof. Andreas Meister (University of Kassel, Germany): Ongoing collaboration May 2022 on development of modified Patankar Runge Kutta method for point reactor kinetics equations
* Dr. Prashant Sharan (Los Alamos National Laboratory, USA): Ongoing collaboration since 2023 on data analysis, machine learning and optimization of desalination process